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(54) **UNINTERRUPTED TRANSMISSION OF INTERNET PROTOCOL TRANSMISSIONS DURING ENDPOINT CHANGES**

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(58) **Field of Classification Search**
None
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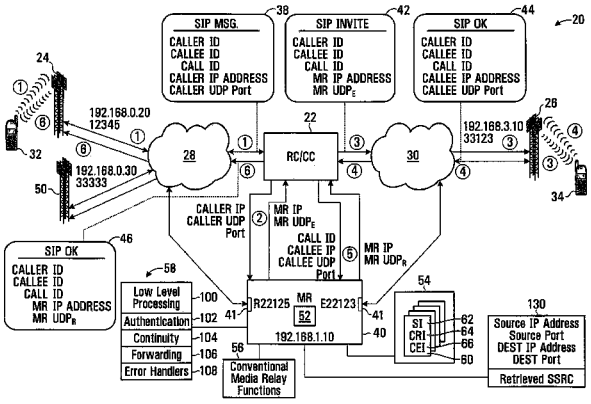
(57) **ABSTRACT**

A method and apparatus providing uninterrupted transmission of IP transmissions, during endpoint changes is disclosed. If a destination identifier in a received IP transmission matches a caller identifier of a record and a source address identifier or source identifier in the transmission do not match a caller address identifier or the caller identifier of the record, and a session identifier in the transmission matches a caller session identifier in the record, the source address identifier and the source identifier in the transmission are set as the caller address identifier and caller identifier respectively of the record. A similar procedure is followed to set the callee address identifier and callee identifier of the record using similar fields associated with the callee.

35 Claims, 6 Drawing Sheets



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CN	101005503	B	1/2013
CN	101772929	B	7/2014
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EP	1 362 456	A4	5/2005
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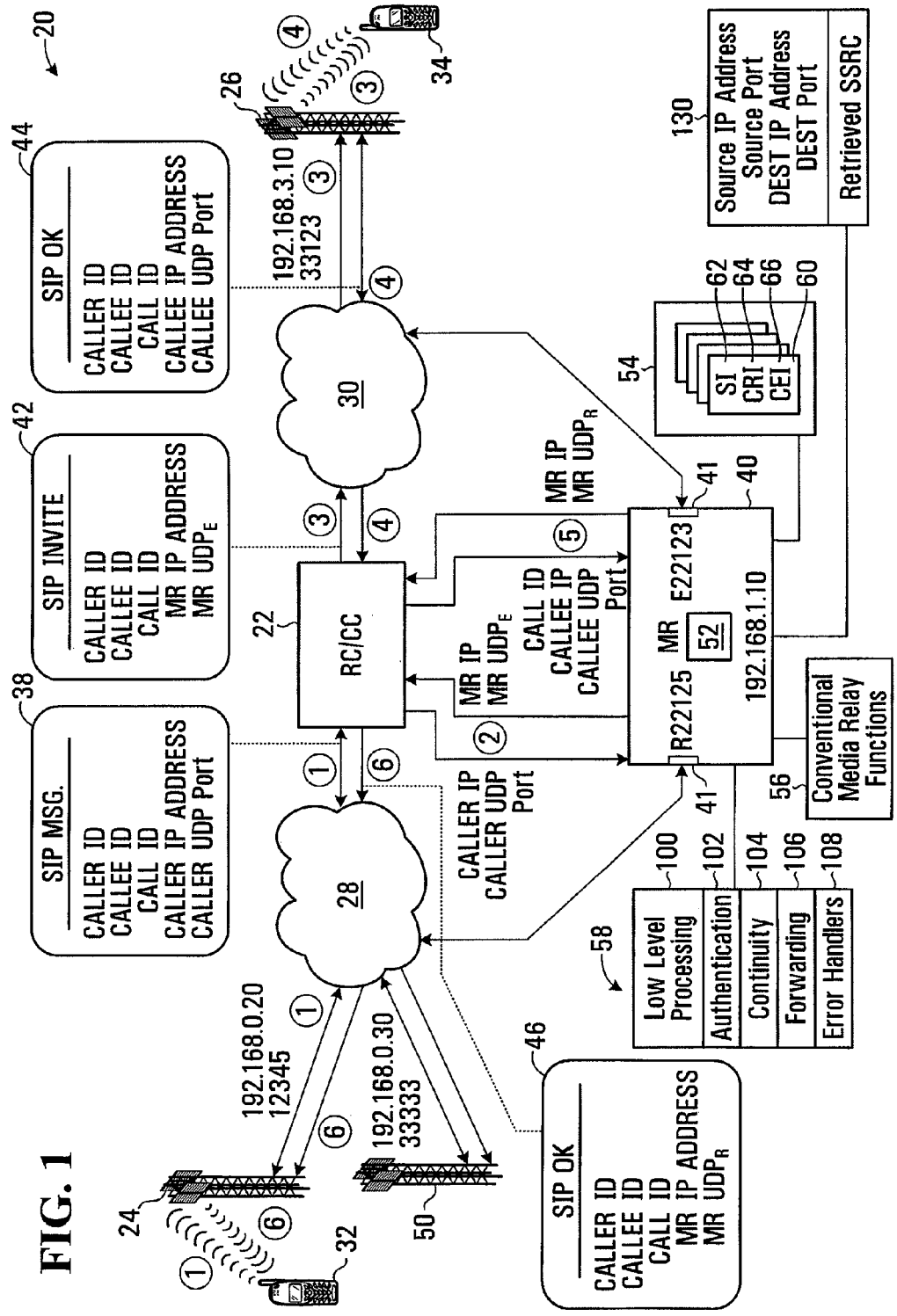
20
SIP MSG.
CALLER ID
CALLEE ID
CALL ID
CALLER IP ADDRESS
CALLER UDP Port
38
SIP INVITE
CALLER ID
CALLEE ID
CALL ID
MR IP ADDRESS
MR UDP$_E$
42
SIP OK
CALLER ID
CALLEE ID
CALL ID
CALLEE IP ADDRESS
CALLEE UDP Port
44
SIP OK
CALLER ID
CALLEE ID
CALL ID
MR IP ADDRESS
MR UDP$_R$
46
RC/CC
22
28
30
192.168.0.20
12345
192.168.0.30
33333
192.168.3.10
33123
CALLER IP
CALLER UDP
Port
MR IP
MR UDP$_E$
CALL ID
CALLEE IP
CALLEE UDP
Port
MR IP
MR UDP$_R$
MR
E22123
52
R22125
192.168.1.10
40
41
41
54
SI
CRI
CEI
62
64
66
60
130
Source IP Address
Source Port
DEST IP Address
DEST Port
Retrieved SSRC
56
Conventional
Media Relay
Functions
58
Low Level
Processing
Authentication
Continuity
Forwarding
Error Handlers
100
102
104
106
108
24
26
32
34
50

FIG. 1

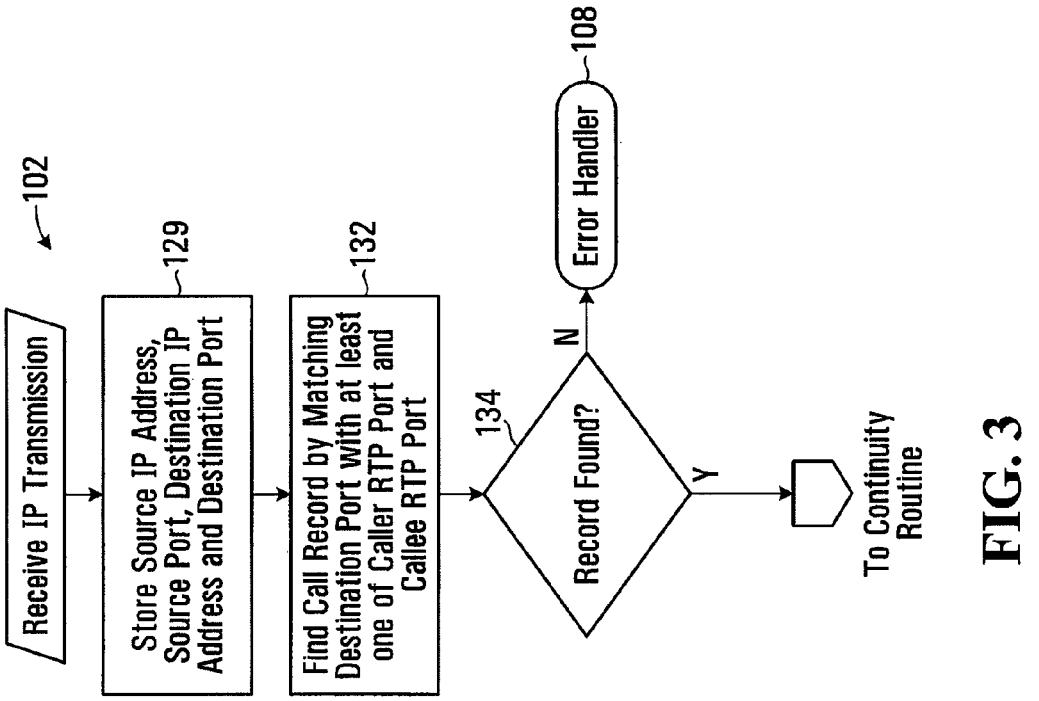
102
Receive IP Transmission
129
Store Source IP Address, Source Port, Destination IP Address and Destination Port
132
Find Call Record by Matching Destination Port with at least one of Caller RTP Port and Callee RTP Port
134
Record Found?
N
108
Error Handler
Y
To Continuity Routine

FIG. 3

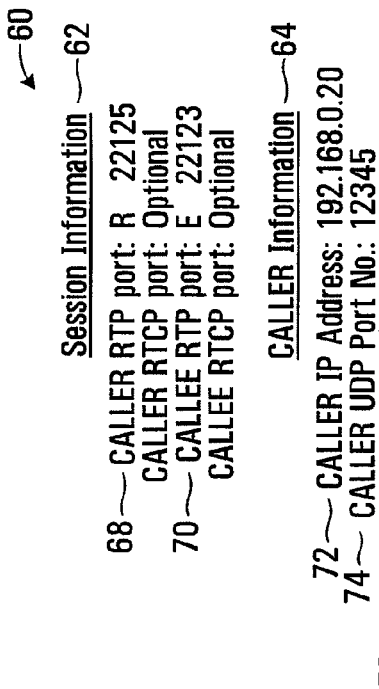
60
Session Information 62
68 CALLER RTP port: R 22125
CALLER RTCP port: Optional
70 CALLEE RTP port: E 22123
CALLEE RTCP port: Optional
CALLER Information 64
72 CALLER IP Address: 192.168.0.20
74 CALLER UDP Port No.: 12345
76 CALLER Sync Source (SSRC):
78 Packets Sent:
80 Packets Received:
CALLEE Information 66
82 CALLEE IP Address: 192.168.3.10
84 CALLEE UDP Port No.: 33123
86 CALLEE Sync Source (SSRC):
88 Packets Sent:
90 Packets Received:

FIG. 2

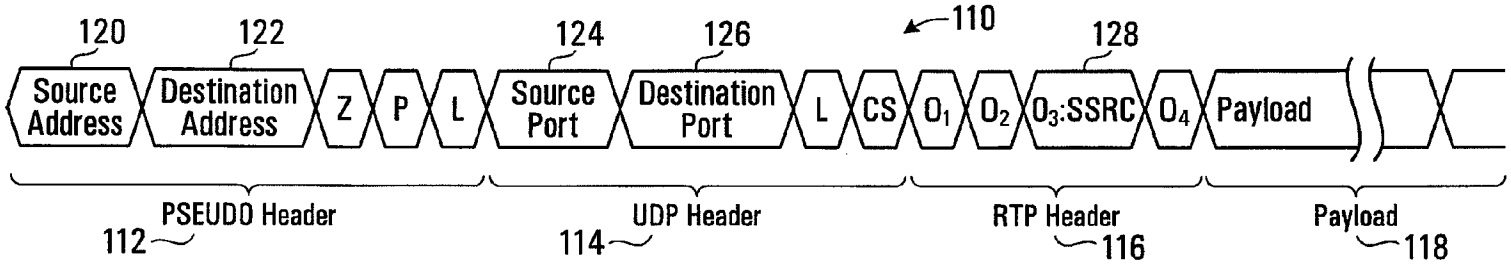

FIG. 4
(Prior Art)

Session Information

CALLER RTP port: R 22125
CALLER RTCP port: Optional
CALLEE RTP port: E 22123
CALLEE RTCP port: Optional

CALLER Information

CALLER IP Address: 192.168.0.20
CALLER UDP Port No.: 12345
CALLER Sync Source (SSRC):
Packets Sent:
Packets Received: 1 —136

CALLEE Information

CALLEE IP Address: 192.168.3.10
CALLEE UDP Port No.: 33123
CALLEE Sync Source (SSRC):
Packets Sent:
Packets Received:

FIG. 5

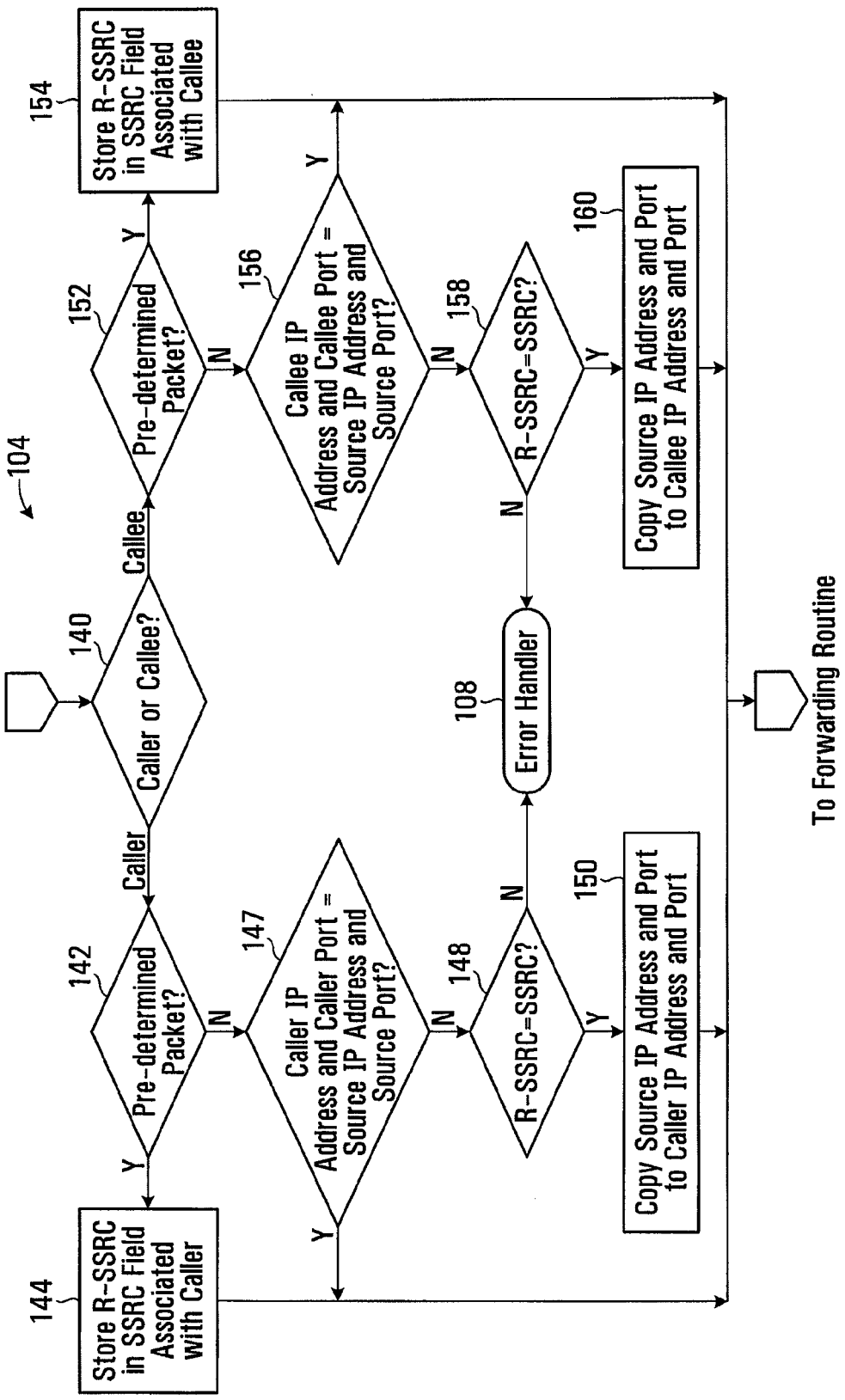
104
140
Caller or Callee?
Caller
Callee
142
Pre-determined Packet?
Y
N
144
Store R-SSRC in SSRC Field Associated with Caller
147
Caller IP Address and Caller Port = Source IP Address and Source Port?
Y
N
148
R-SSRC=SSRC?
Y
N
150
Copy Source IP Address and Port to Caller IP Address and Port
152
Pre-determined Packet?
Y
N
154
Store R-SSRC in SSRC Field Associated with Callee
156
Callee IP Address and Callee Port = Source IP Address and Source Port?
Y
N
158
R-SSRC=SSRC?
Y
N
160
Copy Source IP Address and Port to Callee IP Address and Port
108
Error Handler
To Forwarding Routine

FIG. 6

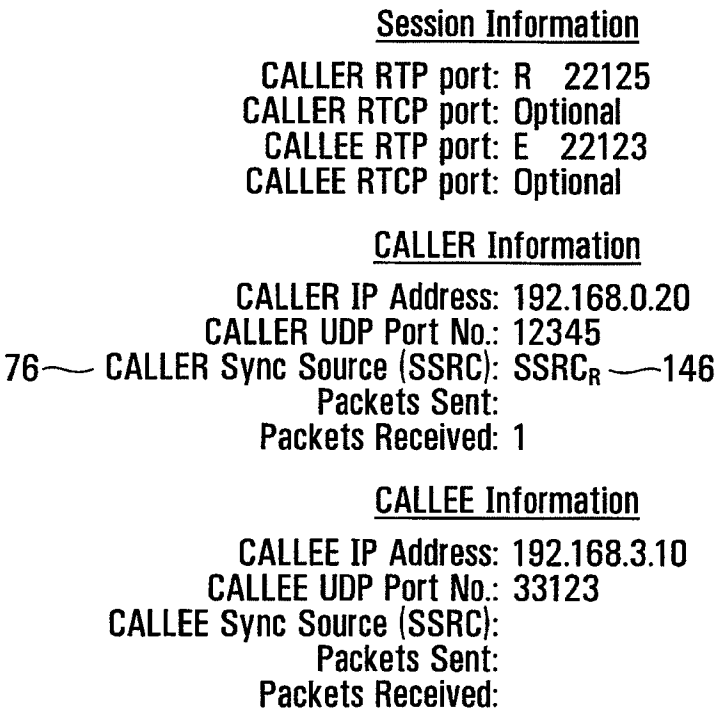
Session Information
CALLER RTP port: R 22125
CALLER RTCP port: Optional
CALLEE RTP port: E 22123
CALLEE RTCP port: Optional
CALLER Information
CALLER IP Address: 192.168.0.20
CALLER UDP Port No.: 12345
76
CALLER Sync Source (SSRC): SSRC$_R$
146
Packets Sent:
Packets Received: 1
CALLEE Information
CALLEE IP Address: 192.168.3.10
CALLEE UDP Port No.: 33123
CALLEE Sync Source (SSRC):
Packets Sent:
Packets Received:

FIG. 7

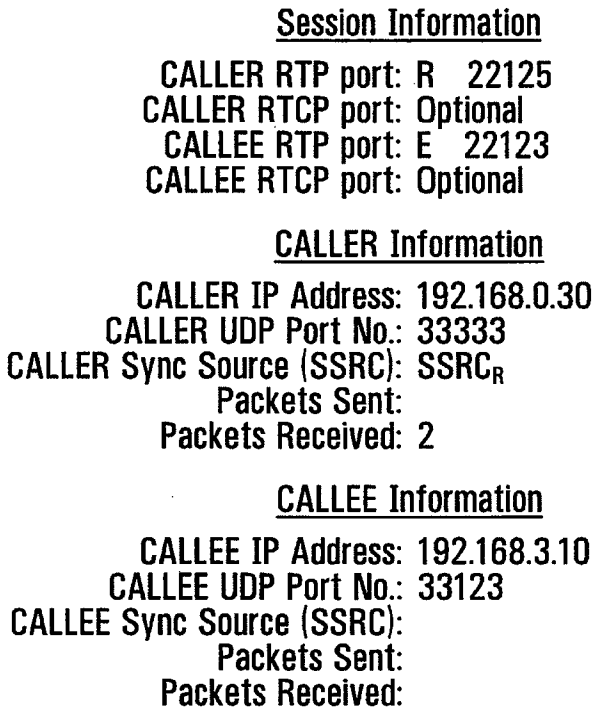
Session Information
CALLER RTP port: R 22125
CALLER RTCP port: Optional
CALLEE RTP port: E 22123
CALLEE RTCP port: Optional
CALLER Information
CALLER IP Address: 192.168.0.30
CALLER UDP Port No.: 33333
CALLER Sync Source (SSRC): SSRC$_R$
Packets Sent:
Packets Received: 2
CALLEE Information
CALLEE IP Address: 192.168.3.10
CALLEE UDP Port No.: 33123
CALLEE Sync Source (SSRC):
Packets Sent:
Packets Received:

FIG. 8

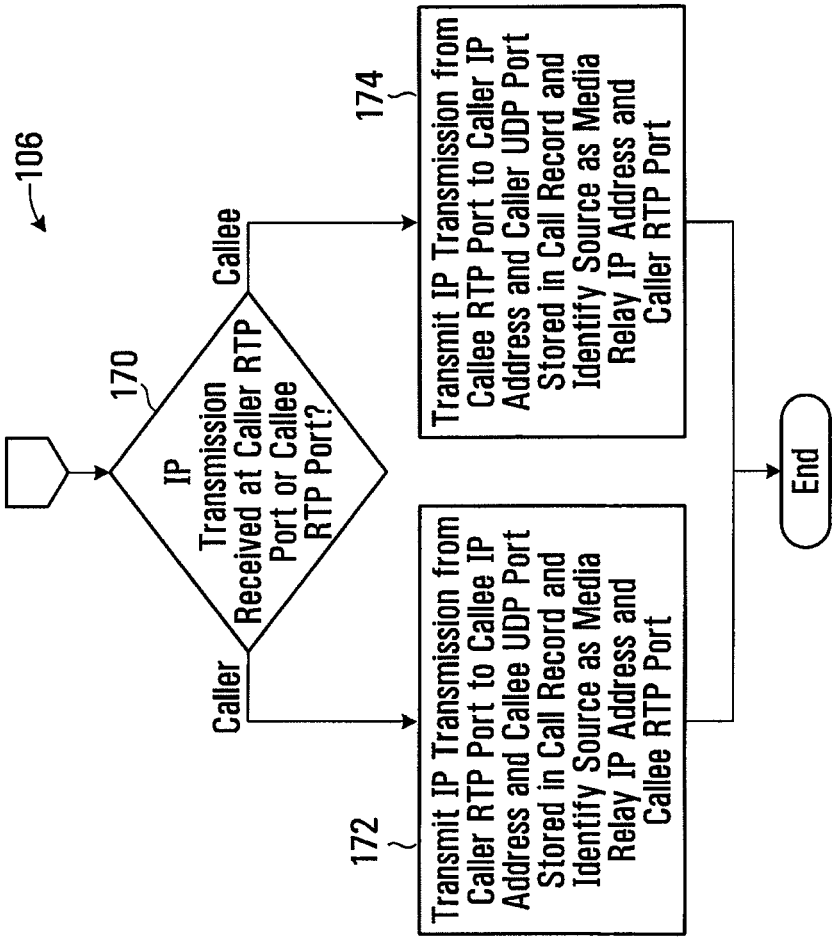
106
170
IP Transmission Received at Caller RTP Port or Callee RTP Port?
Callee
Caller
172
Transmit IP Transmission from Caller RTP Port to Callee IP Address and Callee UDP Port Stored in Call Record and Identify Source as Media Relay IP Address and Callee RTP Port
174
Transmit IP Transmission from Callee RTP Port to Caller IP Address and Caller UDP Port Stored in Call Record and Identify Source as Media Relay IP Address and Caller RTP Port
End

FIG. 9

UNINTERRUPTED TRANSMISSION OF INTERNET PROTOCOL TRANSMISSIONS DURING ENDPOINT CHANGES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 13/496,864, filed Mar. 16, 2012, entitled "Uninterrupted Transmission of Internet Protocol Transmissions During Endpoint Changes", which is a national phase entry of PCT/CA2009/001317, filed Sep. 17, 2009, all of which are incorporated by reference in their entireties.

BACKGROUND

1. Field

This invention relates to Internet protocol (IP) transmissions and, more particularly, to uninterrupted transmission of IP transmissions containing real time transport protocol (RTP) data during endpoint changes.

2. Description of the Related Technology

Internet Protocol (IP) transmission systems are known to use media relays to relay IP transmissions from one endpoint to another. In a telephone system, the media relay relays IP transmissions between a caller and a callee. An IP session is established by a call controller, which interacts with the media relay, the caller and the callee to convey to each of these entities the IP addresses and ports to which they should send IP transmissions and from which they should expect IP transmissions. The media relay is configured to accept packets conveyed by IP transmissions from specified caller and callee IP addresses and ports. In some systems, such as mobile telephone systems, a mobile telephone may be in communication with a first base station while in a certain geographical area and there may be a handoff of the call to another base station when the mobile telephone is moved to a different geographical location. Communications between the base stations and the mobile telephones are conducted on a Global System from Mobile Communication (GSM) network or other cellular network, for example, and the base stations convert messages to and from the GSM network and the IP network and thus, the base stations establish the caller and callee IP addresses and ports. Each base station will have a unique IP address and UDP port number that it associates or assigns to the mobile telephone with which it has established communication in the conventional manner over the cellular network. Thus, a conventional media relay will reject IP streams from the new base station after handoff of the call because such streams are seen as being transmitted by an unauthorized source. This generally prevents voice over IP telephone calls from being made through systems that employ media relays without further call handling.

The Session Initiation Protocol (SIP) RFC 3261 provided by the Internet Engineering Task Force (IETF) specifies a mechanism for an endpoint to notify another endpoint if its IP address changes. This mechanism employs a signaling message that conveys an identification of new media properties for the endpoint whose IP address has changed. The use of SIP messages for this purpose, however, adds extra overhead and delays to the call as signaling messages must be routed through the call controller and the call controller must communicate with the media relay and endpoints to re-configure the media relay to accept IP transmissions from the endpoint having the new IP address and to cause IP transmission to be relayed thereto each time a handoff occurs.

SUMMARY OF CERTAIN EMBODIMENTS

In accordance with one aspect, there is provided a method for facilitating uninterrupted transmission of Internet Protocol (IP) transmissions, during endpoint changes. The method involves, in response to receiving an IP transmission at a caller port or a callee port of a media relay through which IP transmissions of an IP communication session are relayed, locating a session information record having a caller port identifier or callee port identifier matching a destination port identifier in the IP transmission. The caller port identifier identifies the caller port and the callee port identifier identifies the callee port. When the destination port identifier in the IP transmission matches the caller port identifier of the session information record and when a source IP address identifier or a source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record, and when a session identifier in the IP transmission matches a caller session identifier in the session information record, the method involves setting the source IP address identifier and the source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record. When the destination port identifier in the IP transmission matches the callee port identifier of the session information record, and when the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record, and when the session identifier in the IP transmission matches a callee session identifier in the session information record, the method involves setting the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record.

The method may involve maintaining the session information records, each record associating session information, caller information and callee information for a respective IP communication session, and the session information including the caller and callee port identifiers identifying a caller port and a callee port respectively of the media relay through which IP transmissions of the IP communication session are relayed. The caller information may include the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the media relay, and a caller session identifier. The callee information may include the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the media relay, and may further include a callee session identifier.

The method may involve storing the session identifier received in the IP transmission in the caller session identifier field in the session information record, when the pre-determined IP transmission is received from the caller, and storing the session identifier received in the IP transmission in the callee session identifier field in the session information record, when the pre-determined IP transmission is received from the callee.

The method may involve causing the media relay to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record and identifying the source of the IP transmission

forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

The method may involve causing the media relay to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the record and identifying the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

The session identifier may include synchronization source (SSRC) identifier, the caller session identifier may include a caller SSRC identifier and the callee session identifier may include a callee SSRC identifier.

The IP transmission may contain real time transport protocol (RTP) data, the caller port may be a caller RTP port and the callee port may be a callee RTP port.

In accordance with another aspect, there is provided a media relay apparatus for facilitating uninterrupted transmission of Internet Protocol (IP) transmissions during endpoint changes. The apparatus includes connection provisions for providing a connection to an IP network, provisions for defining a logical input/output interface defining caller and callee ports in the connection provisions. The apparatus further includes provisions for relaying IP transmissions of an IP communication session between a caller port and a callee port of the connection provisions. The apparatus further includes provisions for receiving an IP transmission at the caller port or the callee port. The apparatus further includes provisions for locating a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission. The caller port identifier identifies the caller port and the callee port identifier identifies the callee port. The apparatus further includes provisions for setting a source IP address identifier and a source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the caller port identifier of the session information record, and when the source IP address identifier or the source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record, and when a session identifier in the IP transmission matches a caller session identifier in the session information record. The apparatus further includes provisions for setting the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the callee port identifier of the session information record, and when the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record, and when the session identifier in the IP transmission matches a callee session identifier in the session information record.

The apparatus may include provisions for maintaining the session information records, each record associating session information, caller information and callee information for a respective IP communication session. The session information may include the caller and callee port identifiers identifying a caller port and a callee port respectively of the connection provisions through which IP transmissions of the IP communication session are relayed. The caller information may include the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier. The callee information may include the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

The apparatus may include provisions for storing the session identifier received in the IP transmission in the caller session identifier field in one of the session information records, when the pre-determined IP transmission is received from the caller, and provisions for storing the session identifier received in the IP transmission in the callee session identifier field in one of the session information records, when the pre-determined IP transmission is received from the callee.

The apparatus may include provisions for causing the connection provisions to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier respectively and callee port identifier of the session information record, and provisions for identifying the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

The apparatus may include provisions for causing the connection provisions to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record, and provisions for identifying the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

The session identifier may include synchronization source (SSRC) identifier, the caller session identifier may include a caller SSRC identifier and the callee session identifier may include a callee SSRC identifier.

The IP transmission may contain real time transport protocol (RTP) data, the caller port may be a caller RTP port and the callee port may be a callee RTP port.

In accordance with another aspect, there is provided a media relay apparatus for facilitating uninterrupted transmission of Internet protocol (IP) transmissions during endpoint changes. The apparatus includes a processor circuit operably configured to define caller and callee ports on a network and operably configured to relay IP transmissions of an IP communication session between a defined caller port and a defined callee port. The processor circuit is further configured to locate a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission. The caller port identifier identifies the caller port and the callee port identifier identifies the callee port. The processor circuit is further configured to set a source IP address identifier and the source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the caller port identifier of the session information record, and when the source IP address identifier or a source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record, and when a session identifier in the IP transmission matches a caller session identifier in the session information record. The apparatus further includes setting the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the callee port identifier of the session information record, and when the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address

identifier or the callee port identifier respectively of the session information record, and when the session identifier in the IP transmission matches a callee session identifier in the session information record.

The processor circuit may be further configured to maintain the session information records, each record associating session information, caller information and callee information for a respective IP communication session. The session information may include the caller and callee port identifiers identifying a caller port and a callee port respectively through which IP transmissions of the IP communication session to be relayed. The caller information may include the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier. The callee information may include the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

The processor circuit may be further configured to store the session identifier received in the IP transmission in the caller session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the caller, and to store the session identifier received in the IP transmission in the callee session identifier field in the session information record, when the pre-determined IP transmission is received from the callee.

The processor circuit may be further configured to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record, and identify the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

The processor circuit may be further configured to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record, and identify the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

The session identifier may include a synchronization source (SSRC) identifier, the caller session identifier may include a caller SSRC identifier and the callee session identifier may include a callee SSRC identifier.

The IP transmission may contain real time transport protocol (RTP) data and the caller port may be a caller RTP port and the callee port may be a callee RTP port.

In accordance with another aspect, there is provided a media relay apparatus for facilitating uninterrupted transmission of Internet Protocol (IP) transmissions during endpoint changes. The apparatus includes a network interface providing a connection to a network, and a processor circuit in communication with the network interface, the processor circuit including a processor and a non-transitory computer readable medium in communication with the processor. The non-transitory computer readable medium is encoded with codes for directing the processor to define caller and callee ports on the network, and to relay IP transmissions of an IP communication session between a defined caller port and a defined callee port. The codes further include codes for directing the processor to locate a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission. The caller port identifier identifies the caller port and the callee port identifier identifies the callee port. The codes further include codes for directing the processor to set the source IP address identifier and the source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the caller port identifier of the session information record, and when a source IP address identifier or a source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record, and when a session identifier in the IP transmission matches a caller session identifier in the session information record. The codes further include codes for directing the processor to set the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the callee port identifier of the session information record, and when the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record, and when the session identifier in the IP transmission matches a callee session identifier in the session information record.

The non-transitory computer readable medium may be further encoded with codes for directing the processor to maintain the session information records, each record associating session information, caller information and callee information for a respective IP communication session. The session information may include the caller and callee port identifiers identifying a caller port and a callee port respectively of the connection through which IP transmissions of the IP communication session to be relayed. The caller information may include the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier. The callee information may include the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

The non-transitory computer readable medium may be further encoded with codes for directing the processor to store the session identifier received in the IP transmission in the caller session identifier field in the session information record, when the pre-determined IP transmission is received from the caller, and to store the session identifier received in the IP transmission in the callee session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the callee.

The non-transitory computer readable medium may be further encoded with codes for directing the processor to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record, and to identify the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

The non-transitory computer readable medium may be further encoded with codes for directing the processor to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record, and to identify the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

The session identifier may include synchronization source (SSRC) identifier, the caller session identifier may include a

caller SSRC identifier and the callee session identifier may include a callee SSRC identifier.

The IP transmission may contain real time transport protocol (RTP) data and the caller port may be a caller RTP port and the callee port may be a callee RTP port.

In accordance with another aspect, there is provided a non-transitory computer readable medium encoded with codes for controlling a processor of a media relay apparatus to facilitate uninterrupted transmission of Internet Protocol (IP) transmissions during endpoint changes. The codes are operable to cause the processor to cause the media relay to act as a network interface providing a connection to a network, define caller and callee ports on the network, and relay IP transmissions of an IP communication session between a defined caller port and a defined callee port. The codes are also operable to cause the processor to locate a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission. The caller port identifier identifies the caller port and the callee port identifier identifies the callee port. The codes are further operable to cause the processor to further set a source IP address identifier and a source port identifier in the IP transmission as a caller IP address identifier and caller port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the caller port identifier of the session information record, and when a source IP address identifier or a source port identifier in the IP transmission do not match the caller IP address identifier or the caller port identifier respectively of the session information record and when a session identifier in the IP transmission matches a caller session identifier in the session information record. The codes further include codes for directing the processor to set the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when the destination port identifier in the IP transmission matches the callee port identifier of the session information record and when the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record and when the session identifier in the IP transmission matches a callee session identifier in the session information record.

The computer readable medium may be further encoded with codes for directing the processor to maintain the session information records, each record associating session information, caller information and callee information for a respective IP communication session. The session information may include the caller and callee port identifiers identifying a caller port and a callee port respectively of the connection through which IP transmissions of the IP communication session are relayed. The caller information may include the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier. The callee information may include the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

The computer readable medium may be further encoded with codes for directing the processor to store the session identifier received in the IP transmission in the caller session identifier field in the session information record, when the pre-determined IP transmission is received from the caller, and store the session identifier received in the IP transmission in the callee session identifier field in the session information record, when the pre-determined IP transmission is received from the callee.

The computer readable medium may be further encoded with codes for directing the processor to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record, and to identify the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

The computer readable medium may be further encoded with codes for directing the processor to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record, and to identify the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

The session identifier may include synchronization source (SSRC) identifier, the caller session identifier may include a caller SSRC identifier and the callee session identifier may include a callee SSRC identifier.

The IP transmission may contain real time transport protocol (RTP) data and the caller port may be a caller RTP port and the callee port may be a callee RTP port.

Other aspects and features of the present disclosure will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments,

FIG. **1** is a schematic diagram illustrating a system for facilitating uninterrupted transmission of internet protocol (IP) transmissions containing real time transport protocol (RTP) data during endpoint changes, according to a first embodiment.

FIG. **2** is a tabular representation of a call record used by the system shown in FIG. **1**.

FIG. **3** is a flow chart of an authentication routine executed by a processor of a media relay shown in the system shown in FIG. **1**.

FIG. **4** is a schematic representation of an internet protocol (IP) transmission according to the prior art.

FIG. **5** is a tabular representation of the call record shown in FIG. **2** as updated after receipt of an IP transmission at a caller port of the media relay shown in FIG. **1**.

FIG. **6** is a flow chart of a continuity routine executed by the processor of the media relay shown in FIG. **1**.

FIG. **7** is a tabular representation of the call record as updated after execution of the continuity routine shown in FIG. **6** when a pre-determined packet is received in the IP transmission.

FIG. **8** is a tabular representation of the call record shown in FIG. **7** further updated by the continuity routine after an IP transmission received subsequent to the pre-determined packet is received.

FIG. **9** is a flow chart of a forwarding routine executed by the processor of the media relay shown in FIG. **1** to relay the received IP transmission to a caller or callee with a source identification provided by the call record as updated by the continuity routine shown in FIG. **6**.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

Referring to FIG. **1**, a system for handling voice over internet protocol (IP) transmissions and more generally, IP

transmissions, is shown generally at **20**. The system **20** includes a routing controller/call controller (RC/CC) system **22** and first, second and third base stations **24**, **26** and **50**. The base stations **24**, **26** and **50** are operable to communicate with the RC/CC **22** via a network or, as shown in this embodiment, separate networks **28** and **30**, which in this embodiment depict the internet. The first and second base stations **24** and **26** in this embodiment are operable to communicate with caller and callee mobile telephones **32** and **34** respectively using a cellular wireless network in a conventional manner as is known in the art. The first and second base stations **24** and **26** thus act as "endpoints" for IP transmissions between the caller and callee.

Generally, to establish a call from the caller mobile telephone **32** to the callee mobile telephone **34**, the caller mobile telephone transmits to the first base station **24** a session initiation protocol (SIP) message shown generally at **38**. The SIP message **38** is transmitted from the caller mobile telephone **32** to the base station **24** and the first base station **24** formats the SIP message **38** into an IP transmission and transmits the IP transmission through the internet **28** to the RC/CC **22**. In this embodiment, the first base station **24** is preconfigured with a network IP address 192.168.0.20 and universal datagram protocol (UDP) port **12345**.

In response to receipt of the SIP message **38**, the RC/CC **22** communicates with a media relay **40** and sends the caller IP address identifier and caller UDP port identifier contained in the SIP message to the media relay **40** to identify the IP address and UDP port to which the media relay **40** should send communications to the first base station **24** for receipt by the caller mobile telephone **32**.

The media relay **40** has input/output interfaces **41** in communication with the processor to provide for physical connection to an IP network such as the internet. The media relay **40** is programmed to provide a logical input/output interface that interacts with the input/output interfaces **41** to define caller and callee real time transport protocol (RTP) ports in the conventional manner.

In response, the media relay **40** is configured to send a media relay IP address identifier and media relay RTP port identifier that it associates with the callee identified by the contents of the callee ID field in the SIP message **38**. The media relay **40** sends this information to the RC/CC **22** to essentially inform the RC/CC **22** of the media relay IP address identifier and callee RTP port identifier that it should convey to the callee mobile telephone **34** so that the callee telephone can cause IP transmissions to be sent from the second base station, **26** to the media relay **40** which can then subsequently forward those transmissions to the caller mobile telephone **32**.

In response to receipt of the media relay IP address identifier and the callee RTP port identifier designated by the media relay **40**, the RC/CC **22** transmits a SIP invite message **42** through the internet **30** to the callee mobile telephone **34** through the second base station **26**. In this embodiment, the second base station **26** has an IP address (192.168.3.10) and a UDP port number (**33123**). Thus, the RC/CC **22** directs this SIP invite message **42** to the IP address and UDP port associated with the callee mobile telephone **34** by the second base station **26**. The second base station **26** then communicates this SIP invite message **42** to the callee mobile telephone **34** over the wireless network and the callee mobile telephone **34** returns a SIP okay message **44** to the second base station **26**.

The SIP okay message format is shown at **44** and includes a caller identifier (ID), a callee ID, a call ID, a callee IP address identifier and a callee UDP port identifier. The callee IP address identifier is the IP address of the second base station **26** and the callee UDP port identifier is the UDP port identifier associated with the callee mobile telephone **34** by the second base station **26**. The second base station **26** sends the SIP okay message **44** in an IP transmission through the internet **30** to the RC/CC **22** which communicates the call ID, callee IP address identifier, and callee UDP port identifier contained in the SIP okay message **44** to the media relay **40** to identify to the media relay the IP address and UDP port associated with the callee. In response, the media relay **40** sends a reply message to the RC/CC **22** containing a media relay IP address identifier and caller RTP port identifier of a caller RTP port assigned by the media relay, to which the first base station **24** should direct IP transmissions to the media relay for receipt by the callee mobile telephone **34**. In this embodiment, this message includes a media relay IP address identifier of 192.168.1.10 and a caller RTP port identifier (R**22125**).

The RC/CC **22** transmits a SIP okay message **46**, having a format as shown, through the internet **28** to the first base station **24** and the first base station communicates the media relay IP address identifier and the caller RTP port identifier associated with the caller to the caller mobile telephone **32**.

The above basic communications for establishing a call between the caller and callee mobile telephones **32** and **34** are described in further detail in Applicant's related International Application No. PCT/CA2007/002150. Of interest in connection with the present disclosure is the following way in which the media relay **40** is configured to permit the caller mobile telephone **32** to move to another geographical location in which a handoff occurs between the first base station **24** and the third base station **50** having an IP address identifier and UDP port identifier different from that of the first base station **24**.

When a handoff from the first base station **24** to the third base station **50** occurs, the caller mobile telephone **32** ceases communication with the first base station **24** and establishes communication with the third base station **50**. However, since the third base station **50** has a different IP address identifier and UDP port identifier than the first base station **24**, the media relay **40** will receive IP transmissions from the third base station **50** identifying the source of the transmissions with a different IP address identifier and UDP port identifier than those associated with the first base station. Normally, the media relay **40** would reject such communications as being from an unknown source, however, due to the configuration of the media relay described below, IP transmissions from the third base station **50** are not rejected and the call can continue uninterrupted. To facilitate this, the media relay **40** is configured with additional functionality beyond that which merely relays communications between the caller and callee.

It is known that in general, a media relay **40** includes a processor **52**, memory **54** operable to be written to and read by the processor **52**, and program memory **56** containing codes readable by the processor **52** that define program instructions for directing the processor **52** to carry out conventional media relay functions for transferring. IP transmissions between the caller and the callee. In order to provide the functionality of the present disclosure, in this embodiment, the media relay **40** is further configured with additional codes shown generally at **58** that direct the processor **52** to carry out the functionality described below and include functionality for configuring the memory **54** to include call records **60**.

These additional codes **58** may be stored on a computer readable medium such as a CD-ROM, flash drive, or in memory at a remotely located computer and may be downloaded to the program memory **56** or the media relay **40** in a conventional manner, for example.

Referring to FIG. **2**, an exemplary call record is shown generally at **60**. Each call record associates session information **62**, caller information **64** and callee information **66** for an IP communication session (i.e. call) handled by the media relay **40**. The session information **62** includes caller and callee RTP port identifier fields **68** and **70** for storing caller and callee RTP port identifiers identifying caller and callee RTP ports respectively of the media relay **40**. In this embodiment, the caller RTP port identifier is R**22125** and the callee RTP port identifier is E**22123**. The session information **62** may also include a caller RTCP port identifier field and a callee RTCP port identifier field, however, these are optional.

The caller information **64** includes a caller IP address identifier field **72** and a caller UDP port identifier field **74** that hold a caller IP address identifier and caller port UDP identifier to which IP transmissions received at the callee RTP port are to be transmitted. In this embodiment, the caller IP address identifier is 192.168.0.20 and the caller UDP port identifier is **12345** and correspond to those of the first base station **24**, i.e. that associated with the caller. The caller information **64** further includes a caller sync source (SSRC) identifier field **76** for storing a caller sync source identifier associated with the caller side of the IP communication session. In one embodiment, until a pre-determined packet such as a first packet, for example, is received in connection with the call, this caller SSRC identifier is undefined.

In the embodiment shown, the caller information **64** further includes a packets sent field **78** and a packets received field **80** for holding numbers representing the number of packets sent to and received respectively from the caller although these fields are optional and the contents of these fields may be available from other functions on the media relay **40**.

Referring to FIG. **2**, the callee information **66** includes a callee IP address identifier field **82** and a callee UDP port identifier field **84** that hold a callee IP address identifier and callee UDP port identifier identifying a callee address and UDP port to which IP transmissions received at the caller RTP port are to be transmitted. In this embodiment, the callee IP address identifier is 192.168.3.10 and the callee UDP port identifier is **33123** and correspond to those of the second base station **26**, i.e., that is associated with the callee. The callee information **66** also includes a callee sync source (SSRC) identifier field **86** for storing a callee sync source identifier associated with the callee side of the IP communication session. In one embodiment, this callee SSRC identifier field **86** may be unpopulated until a predefined packet such as the first packet, for example, of the IP transmissions associated with the call is received.

In this embodiment, the callee information **66** also includes a packets sent field **88** and a packets received field **90** for storing numbers indicating the number of packets sent to and received from the caller. The call record **60** is populated with the information shown in FIG. **2** during the course of the normal message exchanges between the RC/CC **22**, the caller and callee and the media relay **40** described above that communicate to the caller and callee the media relay IP address and respective RTP port identifiers (R**22125** and E**22123**) to which communications are to be sent.

Referring back to FIG. **1**, the additional codes **58** for directing the processor **52** of the media relay **40** to carry out the functions that facilitate uninterrupted transmissions of IP transmissions include codes **100** for effecting a low level processing routine, codes **102** for effecting an authentication routine, codes **104** for effecting a continuity routine, codes **106** for effecting a forwarding routine and codes **108** for effecting error handler routines. The functionality of the low level processing routine codes **100** is not shown but generally relates to processing associated with layers 0 to 4 of the 7 layer ISO IP transmission protocol.

Referring to FIG. **3**, the functionality of the authentication routine is shown generally at **102**. Before describing this routine, however, please refer to FIG. **4** which describes the generic nature of an IP transmission and the important fields of that transmission for effecting the use of the methods described herein.

In FIG. **4**, an IP transmission is shown generally at **110** and includes a PSEUDO header **112**, a UDP header **114**, a RTP header **116**, and a payload **118**. The PSEUDO header **112** includes various fields, the most important of which, in this embodiment, are source IP address identifier and destination address identifier fields **120** and **122** respectively. The UDP header **114** includes source port and destination port identifier fields **124** and **126** and the RTP header **116** includes a SSRC identifier field **128**. The payload **118** includes data representing, in this embodiment, audio and/or video data transmitted between the caller and the callee.

Referring back to FIG. **3**, the authentication routine **102** is executed in response to receipt of an IP transmission **110** at either the caller RTP port R**22125** of the media relay **40** or at the callee RTP port E**22123** of the media relay. In response to receipt of an IP transmission **110** at either of these ports, the processor **52** of the media relay **40** is directed to store the source IP address contained in the source IP address identifier field **120**, the source port identifier contained in the source port identifier field **124**, the destination IP address contained in the destination IP address identifier field **122** and the destination port identifier contained in the destination port identifier field **126** in fields by the same name in a buffer memory **130** addressable by the processor **52**. The low level processing routine codes **100** will perform the necessary functions to cleanly extract this information and in this embodiment, the storing of this information is effected by the authentication routine **102**, as shown at **129**. Alternatively, the low level processing routine codes **100** may store this information directly in the buffer memory **130**. It will be appreciated that the buffer memory **130** may include separately addressable fields storing the respective information.

Referring to FIG. **5**, upon completion of the execution of block **129** or the low level processing routine codes **100**, the call record **60** is updated with the number of packets received as shown at **136** where it is indicated that one packet has been received from the callee, for example.

Referring back to FIG. **3**, the authentication routine **102** further includes a block **132** that directs the processor **52** to find a call record such as shown at **60** in the memory **54** by matching the destination port identifier with at least one of the contents of the caller RTP port identifier field **74** and the contents of the callee RTP port identifier field **84** of any of the call records. To do this, the codes in block **132** may direct the media relay processor **52** to scan through all of the caller RTP port identifier fields and callee RTP port identifier fields of all of the call records **60** to find a match with the destination port identifier stored in the buffer memory **130**.

Referring to FIG. **3**, block **134** directs the processor **52** to invoke an error handler as shown at **108** if no record is found and to proceed to execute the code **104** associated with the continuity routine if a record is found.

Referring to FIG. **6**, the continuity routine **104** begins with a first block **140** which directs the processor **52** to determine whether or not the IP transmission **110** has been received at the caller RTP port or the callee RTP port.

The identification of whether or not the IP transmission **110** is from the caller or callee can occur in a number of ways. One way, for example, is for the processor **52** to be responsive

to interrupt signals that may be produced by the input/output interface circuitry **41** that physically implements the interface between the media relay **40** and the internet. Since the caller RTP port and callee RTP port have different port identifiers, the input/output interface circuitry **41** may identify the port which has received an IP transmission **110** and cause an interrupt signal and perhaps an interrupt handler (not shown) to be executed by the processor **52** in order to identify the specific port which has received the IP transmission **110**.

Alternatively, when the processor **52** identifies the call record **60** by matching the destination port identifier received from the IP transmission **110** with at least one of the caller RTP port identifier and callee RTP port identifier in a call record, the matching RTP port identifier is inherently identified and this information can be used to identify the specific port that has received the IP transmission **110**. A flag (not shown) may be set for example, to identify whether the IP transmission **110** is from the caller or callee, depending on whether there is a match of the destination port identifier with the callee or caller RTP identifier. Thus, if there is a match of the destination port identifier with the callee RTP port identifier, then the source must be the caller and if there is a match of the destination port identifier with the caller RTP port identifier, then the source must be the callee.

Thus, if a flag is used, block **140** can simply cause the processor **52** to read the flag to determine whether or not the IP transmission **110** is received from the caller or callee.

Assuming the IP transmission **110** is received from the caller, optionally, block **142** can direct the processor **52** to determine whether or not a pre-determined packet has been received. In this embodiment, the pre-determined packet is the first packet and thus can be determined by simply reading the contents of the packets received field **80** in the caller information **64** of the call record **60** identified at block **132** of the authentication routine **102**. Alternatively, the low level processing codes **100** may have previously stored the number of packets received in some other location readable by the processor **52** for use at this stage.

In this embodiment, the first packet received from the caller is the pre-determined packet and thus, when the first packet is received, block **144** directs the processor **52** to store the SSRC identifier received in the IP transmission **110** in the caller SSRC field **76** associated with the caller information **64** of the call record **60** as shown at **146** in FIG. **7**. The processor **52** is then directed to the forwarding routine **106**. If at block **142**, the IP transmission **110** includes a packet that is not the pre-determined packet, in particular, a packet received subsequent to the pre-determined packet, or where there will be no determination as to whether the received packet is a pre-determined packet, block **147** directs the processor **52** to determine whether the caller IP address identifier and caller port identifier in the caller information **64** of the call record **60** match the source IP address identifier and source port identifier received in the IP transmission **110**. If so, the IP transmission **110** has been received from the pre-established source (in this embodiment, the first base station **24**) and therefore, the processor **52** is directed to the forwarding routine **106**.

If at block **147** the caller IP address identifier and caller port identifier do not match the source IP address identifier and source port identifier, then the IP transmission **110** is deemed to be originating from a different source (i.e. the third base station **50**) in which case block **148** directs the processor **52** to determine whether or not the IP transmission is associated with the call represented by the call record **60**. To do this, block **148** directs the processor **52** to determine whether the SSRC identifier received in the IP transmission **110** matches the caller SSRC identifier stored in the caller sync source field **76** of the call record **60** shown in FIG. **7**. If not, the processor **52** is directed to an error handling routine **108**.

If the SSRC received in the IP transmission **110** matches the caller SSRC stored in the caller sync source field **76** of the call record **60**, block **150** directs the processor **52** to copy the source IP address identifier and source port identifier respectively to the caller IP address identifier and caller UDP port identifier fields **72** and **74** respectively of the call record **60** to update the call record to identify the IP address and UDP port of the third base station **50** as that of the caller, as shown in FIG. **8**. The processor **52** is then directed to the call forwarding routine **106**.

Thus, in an IP transmission **110** received subsequent to the pre-determined transmission, or where there is no determination of whether the transmission is a pre-determined one, the source IP address identifier and source port identifier from the IP transmission **110** are set as the caller IP address identifier and caller port identifier respectively of the call record **60** when the caller IP address identifier and caller port identifier of the record do not match the source IP address identifier and source port identifier respectively of the IP transmission **110** and the received SSRC in the IP transmission matches the caller SSRC identifier of the call record.

Similarly, blocks **152**, **154**, **156**, **158**, and **160** function to perform similar functionality when the destination port identifier in the IP transmission **110** matches the callee RTP port identifier of the identified call record **60**. In this case where there is a determination of whether the transmission is a pre-determined one, if the IP transmission is the pre-determined transmission, the SSRC identifier received in the IP transmission **110** is set as the callee SSRC identifier associated with the callee information **66** of the record **60** and if the IP transmission is received subsequent to the pre-determined transmission, or where there is no determination of whether the transmission is a pre-determined one, the source IP address identifier and source port identifier from the IP transmission are set as the callee IP address identifier and callee port identifier respectively of the record when the callee IP address identifier and callee port identifier do not match the source IP address identifier and source port identifier respectively and the received SSRC identifier in the IP transmission matches the callee SSRC identifier.

Referring to FIG. **9**, the forwarding routine is shown generally at **106**. The forwarding routine includes a first block **170** that directs the processor **52** to again determine whether or not the IP transmission **110** has been received at the caller RTP port or callee RTP port. Again, this may be determined by reading the flag described above or by simply reading a memory location identifying the RTP port that received the IP transmission **110**.

If the IP transmission **110** has been received at the caller RTP port, block **172** directs the processor **52** to transmit the IP transmission from the caller RTP port to the callee IP address and callee UDP port identified by the callee IP address identifier and callee UDP port identifier in the call record **60** and to identity the source IP address and source port of the IP transmission as the media relay IP address and callee RTP port. If on the other hand, the IP transmission **110** was received at the callee RTP port, block **174** directs the processor **52** to transmit the IP transmission from the callee RTP port to the caller IP address identified by the caller IP address identifier and caller UDP port identifier stored in the call record **60** and identify the source IP address and source port of the IP transmission as the media relay IP address and caller RTP port. The IP transmission **110** received at either port is thus relayed by the media relay **40** according to the contents

of the call record **60** as previously established by the continuity routine **104** shown in FIG. **6**.

It will be appreciated that in this embodiment, the IP transmissions **110** received from the caller and from the callee may have different SSRC identifiers. Alternatively, they may have the same SSRC identifiers.

What is claimed is:

1. A method for facilitating uninterrupted transmission of Internet Protocol (IP) transmissions, during endpoint changes, the method comprising:

in response to receiving an IP transmission at a caller port or a callee port of a media relay through which IP transmissions of an IP communication session are relayed,

a) locating a session information record having a caller port identifier or callee port identifier matching a destination port identifier in the IP transmission, wherein the caller port identifier identifies the caller port and the callee port identifier identifies the callee port; and

b) when:

i) the destination port identifier in the IP transmission matches the caller port identifier of the session information record; and

ii) a source IP address identifier or a source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record; and

iii) a session identifier in the IP transmission matches a caller session identifier in the session information record:

setting the source IP address identifier and the source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record; and

c) when:

i) the destination port identifier in the IP transmission matches the callee port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record; and

iii) the session identifier in the IP transmission matches a callee session identifier in the session information record;

setting the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record.

2. The method of claim **1**, further comprising:

maintaining the session information records, each record associating session information, caller information and callee information for a respective IP communication session;

the session information including the caller and callee port identifiers identifying a caller port and a callee port respectively of the media relay through which IP transmissions of the IP communication session are relayed;

the caller information including the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the media relay, and a caller session identifier; and

the callee information including the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the media relay, and a callee session identifier.

3. The method of claim **2**, further comprising:

storing the session identifier received in the IP transmission in the caller session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the caller; and

storing the session identifier received in the IP transmission in the callee session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the callee.

4. The method of claim **1**, further comprising:

causing the media relay to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record and identifying the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

5. The method of claim **4**, further comprising:

causing the media relay to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the record and identifying the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

6. The method of claim **1**, wherein the session identifier includes synchronization source (SSRC) identifier, the caller session identifier includes a caller SSRC identifier and the callee session identifier includes a callee SSRC identifier.

7. The method of claim **1**, wherein the IP transmission contains real time transport protocol (RTP) data and wherein the caller port is a caller RTP port and the callee port is a callee RTP port.

8. A media relay apparatus for facilitating uninterrupted transmission of Internet Protocol (IP) transmissions during endpoint changes, the apparatus comprising:

connection means for providing a connection to an IP network;

means for defining a logical input/output interface defining caller and callee ports in the connection means;

means for relaying IP transmissions of an IP communication session between a caller port and a callee port of the connection means;

means for receiving an IP transmission at the caller port or the callee port;

means for locating a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission, wherein the caller port identifier identifies the caller port and the callee port identifier identifies the callee port; and

means for setting a source IP address identifier and a source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the caller port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record; and

iii) a session identifier in the IP transmission matches a caller session identifier in the session information record; and

means for setting the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the callee port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record; and

iii) the session identifier in the IP transmission matches a callee session identifier in the session information record.

9. The apparatus of claim **8**, further comprising:

means for maintaining the session information records, each record associating session information, caller information and callee information for a respective IP communication session;

the session information including the caller and callee port identifiers identifying a caller port and a callee port respectively of the connection means through which IP transmissions of the IP communication session are relayed;

the caller information including the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier; and

the callee information including the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

10. The apparatus of claim **9**, further comprising:

means for storing the session identifier received in the IP transmission in the caller session identifier field in one of the session information records, when the pre-determined IP transmission is received from the caller; and

means for storing the session identifier received in the IP transmission in the callee session identifier field in one of the session information records, when the pre-determined IP transmission is received from the callee.

11. The apparatus of claim **8**, further comprising:

means for causing the connection means to forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier respectively and callee port identifier of the session information record; and

means for identifying the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

12. The apparatus of claim **11**, further comprising:

means for causing the connection means to forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record; and

means for identifying the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

13. The apparatus of claim **8**, wherein the session identifier includes synchronization source (SSRC) identifier, the caller session identifier includes a caller SSRC identifier and the callee session identifier includes a callee SSRC identifier.

14. The apparatus of claim **8**, wherein the IP transmission contains real time transport protocol (RTP) data and wherein the caller port is a caller RTP port and the callee port is a callee RTP port.

15. A media relay apparatus for facilitating uninterrupted transmission of Internet protocol (IP) transmissions during endpoint changes, the apparatus comprising:

a processor circuit operably configured to define caller and callee ports on a network and operably configured to relay IP transmissions of an IP communication session between a defined caller port and a defined callee port, the processor circuit being further configured to:

locate a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission, wherein the caller port identifier identifies the caller port and the callee port identifier identifies the callee port; and

set a source IP address identifier and the source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the caller port identifier of the session information record; and

ii) the source IP address identifier or a source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record; and

iii) a session identifier in the IP transmission matches a caller session identifier in the session information record; and

set the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the callee port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record; and

iii) the session identifier in the IP transmission matches a callee session identifier in the session information record.

16. The apparatus of claim **15**, wherein the processor circuit is further configured to:

maintain the session information records, each record associating session information, caller information and callee information for a respective IP communication session;

the session information including the caller and callee port identifiers identifying a caller port and a callee port respectively through which IP transmissions of the IP communication session are relayed;

the caller information including the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier; and

the callee information including the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

17. The apparatus of claim 16, wherein the processor circuit is further configured to:

store the session identifier received in the IP transmission in the caller session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the caller; and

store the session identifier received in the IP transmission in the callee session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the callee.

18. The apparatus of claim 15, wherein the processor circuit is further configured to:

forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record; and

identify the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

19. The apparatus of claim 18, wherein the processor circuit is further configured to:

forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record; and

identify the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

20. The apparatus of claim 15, wherein the session identifier includes synchronization source (SSRC) identifier, the caller session identifier includes a caller SSRC identifier and the callee session identifier includes a callee SSRC identifier.

21. The apparatus of claim 15, wherein the IP transmission contains real time transport protocol (RTP) data and wherein the caller port is a caller RTP port and the callee port is a callee RTP port.

22. A media relay apparatus for facilitating uninterrupted transmission of Internet Protocol (IP) transmissions during endpoint changes, the apparatus comprising:

a network interface providing a connection to a network;

a processor circuit in communication with the network interface, the processor circuit including a processor and a non-transitory computer readable medium in communication with the processor, the non-transitory computer readable medium being encoded with codes for directing the processor to:

define caller and callee ports on the network;

relay IP transmissions of an IP communication session between a defined caller port and a defined callee port;

locate a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission, wherein the caller port identifier identifies the caller port and the callee port identifier identifies the callee port; and

set the source IP address identifier and the source port identifier in the IP transmission as the caller IP address identifier and caller port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the caller port identifier of the session information record; and

ii) a source IP address identifier or a source port identifier in the IP transmission do not match a caller IP address identifier or the caller port identifier respectively of the session information record; and

iii) a session identifier in the IP transmission matches a caller session identifier in the session information record; and

set the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the callee port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record; and

iii) the session identifier in the IP transmission matches a callee session identifier in the session information record.

23. The apparatus of claim 22, wherein the non-transitory computer readable medium is further encoded with codes for directing the processor to:

maintain the session information records, each record associating session information, caller information and callee information for a respective IP communication session;

the session information including the caller and callee port identifiers identifying a caller port and a callee port respectively of the connection through which IP transmissions of the IP communication session are relayed;

the caller information including the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier; and

the callee information including the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

24. The apparatus of claim 23, wherein the non-transitory computer readable medium is further encoded with codes for directing the processor to:

store the session identifier received in the IP transmission in the caller session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the caller; and

store the session identifier received in the IP transmission in the callee session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the callee.

25. The apparatus of claim 22, wherein the non-transitory computer readable medium is further encoded with codes for directing the processor to:

forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record; and

identify the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

26. The apparatus of claim 25, wherein the non-transitory computer readable medium is further encoded with codes for directing the processor to:

forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record; and

identify the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

27. The apparatus of claim **22**, wherein the session identifier includes synchronization source (SSRC) identifier, the caller session identifier includes a caller SSRC identifier and the callee session identifier includes a callee SSRC identifier.

28. The apparatus of claim **22**, wherein the IP transmission contains real time transport protocol (RTP) data and wherein the caller port is a caller RTP port and the callee port is a callee RTP port.

29. A non-transitory computer readable medium encoded with codes for controlling a processor of a media relay apparatus to facilitate uninterrupted transmission of Internet Protocol (IP) transmissions during endpoint changes, the codes being operable to cause the processor to:

cause the media relay to act as a network interface providing a connection to a network;

define caller and callee ports on the network;

relay IP transmissions of an IP communication session between a defined caller port and a defined callee port;

locate a session information record having a caller port identifier or a callee port identifier matching a destination port identifier included in the IP transmission, wherein the caller port identifier identifies the caller port and the callee port identifier identifies the callee port; and

set a source IP address identifier and a source port identifier in the IP transmission as a caller IP address identifier and caller port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the caller port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match the caller IP address identifier or the caller port identifier respectively of the session information record; and

iii) a session identifier in the IP transmission matches a caller session identifier in the session information record; and

set the source IP address identifier and the source port identifier of the IP transmission as the callee IP address identifier and the callee port identifier respectively of the session information record when:

i) the destination port identifier in the IP transmission matches the callee port identifier of the session information record; and

ii) the source IP address identifier or the source port identifier in the IP transmission do not match a callee IP address identifier or the callee port identifier respectively of the session information record; and

iii) the session identifier in the IP transmission matches a callee session identifier in the session information record.

30. The non-transitory computer readable medium of claim **29**, wherein the computer readable medium is further encoded with codes for directing the processor to:

maintain the session information records, each record associating session information, caller information and callee information for a respective IP communication session;

the session information including the caller and callee port identifiers identifying a caller port and a callee port respectively of the connection through which IP transmissions of the IP communication session are relayed;

the caller information including the caller IP address identifier and the caller port identifier to which IP transmissions received at the callee port are transmitted from the caller port, and a caller session identifier; and

the callee information including the callee IP address identifier and the callee port identifier to which IP transmissions received at the caller port are transmitted from the callee port, and a callee session identifier.

31. The non-transitory computer readable medium of claim **30**, wherein the computer readable medium is further encoded with codes for directing the processor to:

store the session identifier received in the IP transmission in the caller session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the caller; and

store the session identifier received in the IP transmission in the callee session identifier field in the one of the session information records, when the pre-determined IP transmission is received from the callee.

32. The non-transitory computer readable medium of claim **29**, wherein the computer readable medium is further encoded with codes for directing the processor to:

forward the IP transmission to the callee at the callee IP address and callee port identified by the callee IP address identifier and callee port identifier respectively of the session information record; and

identify the source of the IP transmission forwarded to the callee with the callee port identifier, when the IP transmission was received at the caller port.

33. The non-transitory computer readable medium of claim **32**, wherein the computer readable medium is further encoded with codes for directing the processor to:

forward the IP transmission to the caller at the caller IP address and caller port identified by the caller IP address identifier and caller port identifier respectively of the session information record; and

identify the source of the IP transmission forwarded to the caller with the caller port identifier, when the IP transmission was received at the callee port.

34. The non-transitory computer readable medium of claim **29**, wherein the session identifier includes synchronization source (SSRC) identifier, the caller session identifier includes a caller SSRC identifier and the callee session identifier includes a callee SSRC identifier.

35. The non-transitory computer readable medium of claim **29**, wherein the IP transmission contains real time transport protocol (RTP) data and wherein the caller port is a caller RTP port and the callee port is a callee RTP port.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 9,154,417 B2
APPLICATION NO.	: 14/092831
DATED	: October 6, 2015
INVENTOR(S)	: Pentti Kalevi Huttunen

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page References Cited:

In column 1 (page 6, item 56) at line 46, Under Other Publications, change "ViOP" to --VoIP--.

In column 2 (page 6, item 56) at line 61, Under Other Publications, After "No." insert --CN--.

In column 1 (page 7, item 56) at line 3, Under Other Publications, change "Ketchel" to --Ketchpel--.

In column 1 (page 7, item 56) at line 4, Under Other Publications, change "UNISEX" to --USENIX--.

In the Specification:

In column 9 at line 48, Change "station," to --station--.

In column 10 at line 56, Change "transferring." to --transferring--.

In column 14 at line 57, Change "identity" to --identify--.

Signed and Sealed this
Twenty-third Day of August, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office